FARM FACTS

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Aster yellows

Ongoing diversification into canola, vegetable, herb and spice production by Saskatchewan producers brings with it the potential for new disease problems. One of these diseases is aster yellows.

Aster yellows disease can be identified by stunted growth and malformed flowers and pods. Infected plants typically do not produce seed. Aster yellows can over-winter in the living crowns of perennial crops and weeds or it can be brought into Saskatchewan by the aster leafhopper as it migrates from the United States.

Aster yellows is quite common in Saskatchewan, but usually at such low incidences that it does very little damage to susceptible crops. For example, typically less than one plant in 100 is infected, although higher incidences may have a significant impact on yield. Conversely, the level of aster yellows can increase yearly in perennial crops, resulting in significant loss.

There has been an increase in the incidence of aster yellows in canola and some herb and spice crops over the past couple of years. This information sheet focuses primarily on aster yellows in canola as well as in herb and spice crops such as echinacea, coriander and caraway. The very obvious symptoms of aster yellows often make the disease look more severe than it actually is. Counting the number of infected plants in a random sample of 100 will determine the percentage of infection.

What is Aster Yellows?

Aster yellows can infect a wide variety of crops, including canola, alfalfa, flax, sunflower, echinacea, caraway, coriander, carrot, pea, ornamental plants, weeds and, to a lesser extent, cereals.

Aster yellows is caused by a phytoplasma, a plant pathogenic micro-organism. The phytoplasma inhabits the phloem (nutrient-carrying vessels) of infected plants and is carried from plant to plant by sap-sucking leafhoppers. Not all leafhoppers are infected with the pathogen. Leafhopper feeding, in itself, is not considered an economic threat to crops.

The pathogen can over-winter in biennial and perennial crops and weeds—providing a disease source for the next year—but most infections are carried north from the United States by migrating leafhoppers. The phytoplasma survives in living plant tissue and is not soil- or seed-borne.

The extent of an aster yellows infection is dependent on:

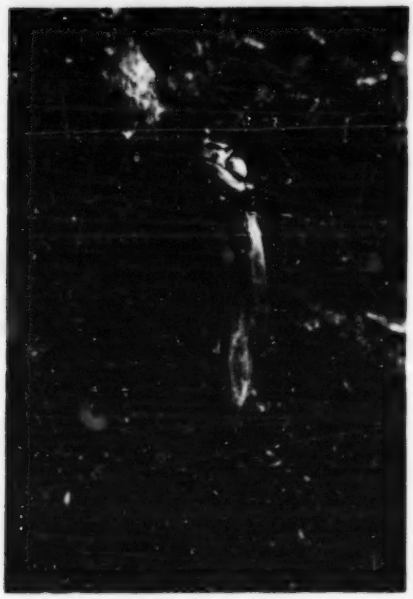
- local and migratory leafhopper populations
- the number of infective leafhoppers
- the proximity of healthy susceptible plants to infected plants
- weather conditions.

The Aster Leafhopper

The primary vector of the aster yellows phytoplasma is the aster leafhopper, also known as the six-spotted leafhopper (Figure 1). Leafhoppers are small, narrow, wedge-shaped insects that have a beak, tiny antennae and long hind legs fringed with hairs. The aster leafhopper is yellow or yellow-green with six black spots arranged in three rows on its head.

Leafhoppers undergo a series of nymphal stages before reaching adulthood. Nymphs resemble a wingless adult but are much smaller, ranging in size from 0.6mm to 3mm. They can often be distinguished by their unique

Figure 1 Adult aster leafhopper. Photo supplied by M. Herbut, ARC



sideways scuttle when disturbed. Adults range from 3.5mm to 4mm. They are relatively poor fliers and tend to glide along with wind currents.

Generally, the migratory leafhoppers pose a greater threat to crops than the local population since the migrants may arrive already infective with aster yellows phytoplasma. Migratory leafhoppers follow the air currents up from the southeastern and central United States and onto the Canadian prairies. Leafhoppers usually arrive in Saskatchewan in early to mid-June, but this may vary depending on the prevailing winds.

Leafhoppers tend to take flight only when the air temperature exceeds 15°C. Cooler temperatures or rain will temporarily stop their migration. Due to the leafhoppers' poor flying ability, aster yellows tends to proliferate in patches along the edge of a field. There have been reports of adult aster leafhoppers appearing in the spring, suggesting that they may be able to over-winter as adults. While this has not been confirmed, it could help explain the significant increase in aster yellows in recent years. In Saskatchewan, leafhopper populations increase quickly and remain relatively high all summer.

Disease Transmission

Hot and dry conditions are not conducive to the spread of aster yellows, whereas abundant rainfall will make plants more succulent and attractive to leafhoppers.

The aster yellows phytoplasma is transmitted when the leafhopper feeds on a plant's sap. A leafhopper has to feed on an infected plant for a substantial period of time to acquire the pathogen (8 hours for 50% success). An incubation period of 10 to 18 days is necessary for the phytoplasma to circulate and reproduce within the insect before it becomes infective. The infective leafhopper must then feed on a healthy plant for a sustantial period of time (8 hours for 50% success) to pass on the phytoplasma.

Once infective, the leafhopper can continue to pass on the phytoplasma for as long as it lives (about a month or more). As a result, the insect can carry the pathogen over great distances if the winds are favourable. The phytoplasma is not transmitted from adult to egg.

Since the phytoplasma pathogen can over-winter in living host tissue, local plants can serve as a source of the aster yellows phytoplasma in the spring.

Disease Symptoms

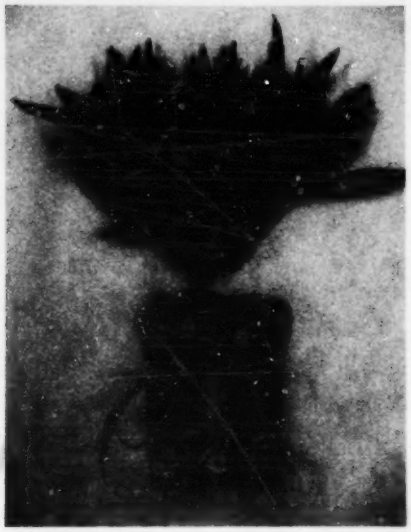
Caraway, coriander and echinacea

The symptoms of aster yellows vary, depending on the infected plant. A yellow discolouration of leaves is typical in many—but not all—plants. The leaves of infected caraway and coriander plants will turn yellow or light green in colour (Figure 2). Top growth may be stunted with a proliferation of secondary shoots.

Figure 2 Aster yellows in biennial caraway. Leaves are stunted and yellow. Roots have developed proliferation of lateral roots. Photo by SAF

In echinacea, infected leaves will turn yellow or purple and will often appear thin and upright (Figure 3). The roots of echinacea or biennial caraway may be stunted in size with a proliferation of lateral roots known as a "witch's broom".

Figure 3 Aster yellows in echinacea. Leaves are stunted and narrow. Root has been infected with secondary rot. Photo by SAF



Severely infected roots usually will not survive the winter due to their susceptibility to secondary rots, nutrient deficiencies and adverse environmental conditions.

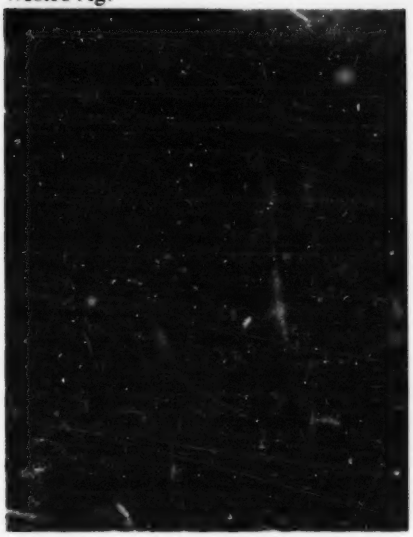
Floral parts are replaced by malformed, sterile leaf-like structures. In herbs and spices, seed production can be devastated.

Younger, actively growing plants often develop symptoms within several days of infection, while older plants may take several weeks to show symptoms. Echinacea and biennial caraway that emerge in the spring already showing signs of aster yellows were likely infected during the previous fall.

Canola

In canola, infected plants are often blue-green, with leaves developing a red or purple tinge later in the season (Figure 4). Malformed flowers and pods are the most obvious symptoms of aster yellows in canola. Flowers are replaced by sterile, green leaf-like structures, and pods are replaced by round or oval blue-green hollow, flattened structures.

Figure 4 Asters yellow in canola. Flowers are replaced by sterile, leaf-like structures and pods are malformed. Plants may turn purple or blue-green. Photo supplied by L. Coutts, Westco Ag.



The infected plants may become woody and are often taller than the rest of the plant canopy. The incidence of aster yellows in canola is often exaggerated due to the distinctive symptoms and erect nature.

Younger, actively growing plants may develop symptoms within several days of infection. Plants that become infected later in the season can continue to develop pods, but seed development may be adversely affected.

Symptoms That Can Be Mistaken for Aster Yellows

Aster yellows symptoms can be confused with injury caused by nutrient deficiencies, Group 4 herbicides containing growth regulators, drought or other environmental stresses. For example, nitrogen deficiency in echinacea will usually result in the yellowing of older leaves. The rest of the plant will appear normal.

In canola, purpling is caused by anthocyanin production as a result of stress. Although aster yellows can cause purpling, a purple plant does not necessarily indicate an aster yellows infection.

Disease Diagnosis

The Saskatchewan Agriculture and Food Crop Protection Lab in Regina (306-787-8130) can visually diagnose aster yellows for a nominal fee. To confirm the presence of the phytoplasma, a more expensive test is available from the Alberta Research Council in Vegreville (780-632-8225).

Disease Management

The proper techniques for managing aster yellows are dependant on the type of crop involved. Monitoring of leafhoppers and early detection of aster yellows symptoms are important for those crops in which hand-removal of diseased plants is feasible.

For field crops, there are very few management options available.

Crop rotation will not reduce aster yellows because it is not a soil-borne disease, and most crops are susceptible to the phytoplasma. There are no fungicides available to control aster yellows. Furthermore, no varieties of any of the susceptible crops have resistance to the aster yellows phytoplasma. It is possible to choose varieties that may avoid infection because they deter leafhopper feeding. For example, the more pubescent *Echinacea augustifolia* is less favoured by leafhoppers than other species.

Disease management in canola, coriander, biennial caraway
Normally, there is little need to control aster yellows in annual field crops since incidence of the disease is usually low and does not result in significant economic loss. Management of aster yellows in annual crops is limited to:

- Seeding crops in the fall or as early in the spring as possible. This may help avoid infection since the crop has a chance to mature, making it less attractive to the migrating leafhoppers.
- Controlling perennial weeds in and around susceptible crops. Weeds can also be a source of the aster yellows phytoplasma.
- Not planting near perennial forages, herbs or spices that are known to be infected with aster yellows.
- Using insecticides (active ingredient dimethoate) that are registered for leafhopper control in canola. Refer to the *Guide to Crop Protection* for details. Several applications may be needed over the course of the season as new leafhoppers move into the area.

Disease management in echinacea
In addition to the above-mentioned management practices, disease management in perennial herb crops include:

- Removing and destroying **all** plants showing aster yellows symptoms. Removing only the above-ground plant parts may help limit the spread of disease that season but, since the roots are infected, any new foliage will be carrying the phytoplasma.
- Isolating the crop as much as possible. Tilling or mowing around the crop will remove weeds and grasses where leafhoppers or their eggs may be sheltering.
- Applying insecticides to the area surrounding the crop. There are some organic products that may be used on the crop. **Organic producers should check with their certification agency guidelines.** Research is under way on organic control options such as rotenone, pyrethrum with fatty acid soap, diatomaceous earth, garlic oil and neem extract.
- Growing the crop in tandem with repellent plants such as yarrow, tansy or mint.
- Using only healthy plants for vegetative propagation.

Economic Thresholds

There has been an aster yellows index developed for vegetable producers in Ontario and the U.S. Midwest to determine when leafhopper populations are high enough to warrant insecticide applications. No similar economic thresholds have been established for canola, forage or herbs and spices.

Sticky traps or sweep nets can be used to monitor the presence of leafhoppers and give producers an early warning of potential trouble, but there is no easy method of determining whether or not the insects are infective.

Additional information

Saskatchewan Agriculture and Food:
- Rural Service Centres
- Website: **www.agr.gov.sk.ca/**

Alberta Agriculture, Food and Rural Development
7000 - 113St.
Edmonton Alberta
T6H 5T6
- Website: **www.agric.gov.ab.ca/**
- Publications:
  - *Yellows Diseases of Echinacea, Manarda and Caraway*
  - *Diseases of Echinacea on the Canadian Prairies*

Ontario Ministry of Agriculture, Food and Rural Affairs
- Website: **www.gov.on.ca/OMAFRA/english/crops**

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